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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
E06B 5/10, 5/12, 3/00
E04C 2/54, E05G 7/00

A1

(11) International Publication Number: WO 93/02269

(43) International Publication Date: 4 February 1993 (04.02.93)

(21) International Application Number: PCT/AU92/00361

(22) International Filing Date: 17 July 1992 (17.07.92)

(30) Priority data:
PK 7264 17 July 1991 (17.07.91) AU

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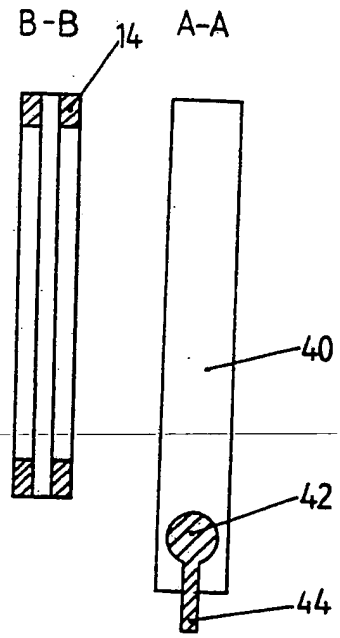
(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CS, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, PL, RO, RU, SD, SE, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, MC, NL, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).

Published
With international search report.

(54) Title: TRANSPARENT LAMINATES AND MONOLITHIC TRANSPARENCIES

(57) Abstract

A transparent laminate comprising at least two transparent layers, a transparent interlayer bonded therebetween and a stiffening member (14), the interlayer having at least one free surface to which the stiffening member (14) is bonded. Also a monolithic transparency comprising a transparent polymer or resin (40) having a cavity adjacent an edge, and a stiffening member (42, 44) partially located in the cavity and extending from the transparency.



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TRANSPARENT LAMINATES AND MONOLITHIC TRANSPARENCIES

FIELD OF THE INVENTION

The invention relates to transparent laminates and monolithic transparencies for use in applications requiring resistance to physical penetration including physical attack and/or blast attack and/or fluid pressure applied by gas or liquid. Typically, banks, prisons, government buildings, computer centres and retail stores may be at risk from attempts to penetrate a window for the purposes of theft, entry, escape or vandalism.

Also, windows on buildings, trains, boats, aircraft and other vehicles may be subject to penetration from fluid pressure (wind or water), mechanical impact, blast or ballistic attack.

BACKGROUND

Transparent barriers (transparencies) are commonly interposed at building perimeters and/or at the perimeter of defined interior areas to control access to cash, valuables, data, personnel etc. These barriers may be permanent fixtures or be caused to take two or more positions using mechanical means.

In the case of permanent barriers, these usually comprise transparencies held in position in channels which are themselves affixed to permanent structures such as walls or floors.

As indicated, another form of barrier is a temporary barrier which is caused to change position and this may run along or in or be guided by channelways which are affixed to a permanent structure.

In either situation the transparency allows visual contact but is resistant to the perceived threat whether ballistic and/or physical attack and/or blast.

While the transparency should not be penetrated by a threat for which it is rated, it may change in appearance, degree of transparency and/or stiffness. In particular transparencies composed of glass clad polymers may sustain cracking or breakage of one or more of the glass layers and become more flexible as a result. The resulting transparency can take on significant curvature as a result of the initial attack or under the influence of continued attack.

When using such types of laminates it has been found that under severe impact conditions the laminate may flex enough to permit the edges of the laminate to disengage from the channels, in which they are normally retained. Consequently, these security barriers can be flexed out of their original position and enable an intruder to gain access to a secured area, or in the event of a pressure wave the transparency may be sufficiently flexed even in an unbroken state that it is displaced and propelled by the blast wave from its fixing. Accordingly, investigations have been carried out in an effort to improve the construction of such transparencies.

DESCRIPTION OF THE INVENTION

Accordingly, in one aspect of the invention a transparent laminate is provided which comprises at least two transparent layers, a transparent interlayer bonded therebetween and a stiffening member, the interlayer having at least one free surface to which the stiffening member is bonded.

In a second aspect of the invention a monolithic transparency is proposed comprising a transparent polymer having a cavity adjacent an edge thereof, and a stiffening member partially located in the cavity and extending from the transparent polymer.

Preferably the stiffening member is metal though polymers such as polycarbonate, acrylic or fibre reinforced resin may be used.

Preferably, the interlayer is a polymer or resin layer. The polymer layer which is preferred is manufactured under the trade mark "Noviflex". Examples of these polymers are disclosed in US Patent nos. 4,619,973 and 4,663,228. Th disclosure in these patents is incorporated herein. When

considering a monolithic transparency, resins such as acrylics, epoxys or polyesters are preferred as they exhibit the desired transparency and ability to be moulded with stiffening members without undesirable chemical or mechanical reactions.

Preferably the transparent layers are glass. Suitable glass may be annealed, chemically toughened, heat strengthened or thermally toughened. Other transparent layers may be composed of polycarbonates or similar resistant transparent materials.

Investigations have shown that the use of a stiffening member in contact with the polymer improves the overall resistance of the barrier to removal from its location. This arrangement also permits the stiffening member to act as an anchor or mounting point.

In another preferred embodiment of the invention, a number of stiffening members may be used. For example in the case of a square barrier the stiffening members may extend about the periphery of the barrier. Alternatively the stiffening members may only run across the opposing edges of the barrier.

In another preferred form of the invention the portion of the interlayer extending beyond the edge of the transparent layers is provided with an opening which corresponds with an opening in the stiffening member. In such an arrangement, a fastening device can be passed through these openings to anchor the security barrier into any desired position. Alternatively, such openings may be counter-sunk and thus the interlayer may flow in the openings with the effect of riveting the stiffening member to the interlayer.

The particular shape of the transparent layers or the interlayers is not critical. Typically the transparent layers are planar but could be curved or take on other two or three dimensional shapes e.g. square, circular and spherical. As such the invention does not substantially interfere with the desired architectural design of the security barrier.

It has been surprisingly found that the direct contact between the stiffening member and the transparent interlayer enables fixing or alternatively reduces the potential for the security barrier to be removed from the anchorage channels by flexing.

Similarly, this arrangement enables various forms of fixing which have been hitherto unknown with conventional security barriers.

DESCRIPTION OF THE DRAWINGS

The invention is further illustrated with reference to the drawings in which:

Figure 1 is a front view of a security barrier according to one form of the invention.

Figure 2 is a cross sectional view along section A-A of figure 1.

Figure 3 is a cross sectional view along section B-B of figure 1.

Figure 4 is a front view of a second form of the invention.

Figure 5 is a cross-sectional view along section A-A of figure 4.

Figure 6 is a front view of a third form of the invention.

Figure 7 is a cross section along section A-A of figure 6.

Figure 8 is a cross section along section B-B of figure 6.

Figure 9 is a front view of a fourth form of the invention.

Figure 10 is a cross section along section A-A of figure 9.

Figure 11 is a cross-sectional view along section B-B of figure 9.

Figure 12 is a front view of a fifth form of the invention.

Figure 13 is a cross-sectional view along section A-A of Figure 12.

Figure 14 is a front view of a sixth form of the invention.

Figure 15 is a cross-sectional view along section A-A of Figure 14.

The first form of the invention is shown in figures 1 to 3 inclusive. A security barrier 10 has a pair of transparent layers 11 and 12 separated by an interlayer 13. This arrangement defines the visual area A. Interlayer 13 extends beyond the edges of transparent layers 11 and 12 to form a peripheral skirt. A metal member 14 is placed on each side of that skirt. As more particularly seen from figure 1 the metal member 14 covers the entire periphery of the security barrier 10. Whilst metal layer 14 is shown as continuous, it can of course be made up of strips of metal.

Anchoring apertures 15 are also provided in metal layer 14 which align with apertures 16 also formed in interlayer 13. This enables the security barrier 10 to be fixed into position with fasteners (not shown).

In manufacture the transparent layers 11 and 12 are cleaned and together with interlayer 13 and metal member 14 are placed into position. Where the interlayer 13 is of the type disclosed in US Patent no. 4,619,973, bonding is carried out by placing the laminate into an autoclave at a temperature of approximately 130^{o}C and at a pressure of approximately 7 bar. This bonding has been found to be particularly resistant to separation and results in a highly stable laminate. There is not necessarily direct fusing between metal layer 14 and transparent layers 11 or 12. However these are indirectly adhered by interlayer 13 flowing therebetween.

Figures 4 and 5 depict a second embodiment of the invention. In particular it is common in the security barrier industry to build up the thickness of a laminate by placing a number of interlayers on top of one another to increase the overall interlayer thickness. The greater the desired strength of the security barrier the greater the number of interlayers utilised.

In the embodiment shown in Figures 4 and 5, three interlayers 17, 18 and 19 are placed together. Transparent layers 20 and 21 are added to the exterior of interlayers 17 and 19. Interlayer 18 is of lesser width than the width of interlayers 17 and 19 and between them define cavities 22. Metal members 23 are placed into cavities 22. This arrangement enables the interlayers 17, 18, and 19 to bond to three separate faces on metal strip 23. This sandwich effect improves the security of the barrier from considerable flexing which may under normal circumstances causes it to be disengaged from its located position. Metal strip 23 has a flanged portion 24 in which apertures may be formed to provide additional locating and anchorage points to existing structures.

Again, the arrangement can be assembled and bonded.

Figures 6 to 8 depict another form of the invention particularly adapted to enable fittings to be attached to security barriers.

More particularly, as shown in the drawings, the security barrier 25 comprises an interlayer 26 sandwiched between outer transparent layers 27 and 28. Transparent layers 27 and 28 are not continuous and each define a square area 29 into which the transparent layers 27 and 28 do not extend.

Metal members 30 and 31 are inserted in these areas. These metal plates 30 and 31 and interlayer 26 have an aligned aperture 32 which enables fittings or other accessories to be securely fixed on either side of the security barrier or allows the barrier to be anchored from locations remote from its edge.

In this embodiment, the fittings can be secured to the face of a transparent panel and the stresses set up in attempting to anchor material directly to transparent layers 26 and 27, such as glass, are avoided.

A further more complex form of the invention is shown in figures 9, 10 and 11. More particularly, a mosaic security barrier 33 has a number of transparent panels 34. This laminate 33 is formed by taking an interlayer 35 and overlaying and underlaying this interlayer 35 with square

transparent layers 36. The transparent layers 36 define channels therebetween into which metal members 37 are placed. A border of metal layer 38 surrounds the entire mosaic. The same arrangement is formed on the rear surface of the security laminate 33.

The addition of metal layers in this embodiment serves to restrict the transparency of the arrangement and to improve the rigidity of the security barrier. In such a situation it would be difficult for the security barrier to be penetrated. Not only would an intruder need to penetrate through the transparent layers and the interlayer but they would also need to overcome the strength of the metal layer.

An alternate form of the invention is shown in figures 12 and 13. A monolithic transparency 39 is composed of a polymer or resin sheet 40 in which an anchor 41 is embedded. The anchor 41 has a cylindrical rod portion 42 which is located in a cavity in sheet 40. Arms 43 and 44 connect to cylindrical rod portion 42 and extend from sheet 40. These arms 43 and 44 may be used to anchor the transparency 39 into any desired position.

A similar form of the invention is shown in figures 14 and 15, in which a monolithic transparency 45 comprises a polymer or resin sheet 46 from which an anchorage bar 47 extends. The anchorage bar 47 is connected to a square bar 48 embedded in sheet 46.

In both these embodiments the anchor can be formed into the sheet by positioning it and causing the polymer to flow around it. This causes the sheet to encase the rod or bar. As these have a width greater than the arms or anchor which extends from the sheet they are firmly held in place by the encasing sheet.

All the above embodiments illustrate how the invention serves to improve the anchorage and rigidity of the security laminate. The anchorage points which are formed make it difficult for the polymer to be flexed sufficiently to be torn or displaced. Similarly, by using these types of arrangements it is possible to provide mounting areas for other fittings.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A transparent laminate comprising at least two transparent layers, a transparent interlayer bonded therebetween and a stiffening member, the interlayer having at least one free surface to which the stiffening member is bonded.

2. A laminate according to claim 1 wherein the at least one free surface is formed by the interlayer extending from between the transparent layers.

3. A laminate according to claim 2 wherein two or more free surfaces are formed by the interlayer extending from between the transparent layers in more than one direction.

4. A laminate according to any one of claims 1 - 3 wherein the security laminate is rectangular.

5. A laminate according to claim 4 wherein each layer is rectangular and the interlayer has dimensions larger than the dimensions of the transparent layers and the stiffening member is bonded to the free surface of the interlayer which extends from between the transparent layers.

6. A laminate according to claim 1 wherein each of the transparent layers has an aperture and the aperture of each transparent layer is aligned with one another, and the stiffening member is bonded to the interlayer in the aperture.

7. A laminate according to claim 1 comprising two transparent layers and three interlayers located therebetween, the interlayers forming a recess in which the stiffening member is located.

8. A transparent laminate according to claim 1 in which the stiffening member has means by which the laminate can be attached or anchored to a surrounding structure.

9. A transparent laminate according to any one of claims 1 to 8 in which the transparent layers are comprised of glass.

10. A transparent laminate according to claim 9 in which each piece of the glass has been annealed, chemically toughened, heat strengthened or thermally toughened.

11. A transparent laminate according to any of claims 1 to 9 in which the stiffening member is composed of metal, polycarbonate, acrylic or fibre reinforced resin.

12. A monolithic transparency comprising a transparent polymer or resin having a cavity adjacent an edge thereof, and a stiffening member partially located in the cavity and extending from the transparent polymer or resin.

13. A monolithic transparency according to claim 12 wherein the transparent polymer or resin is laminated to a transparent layer.

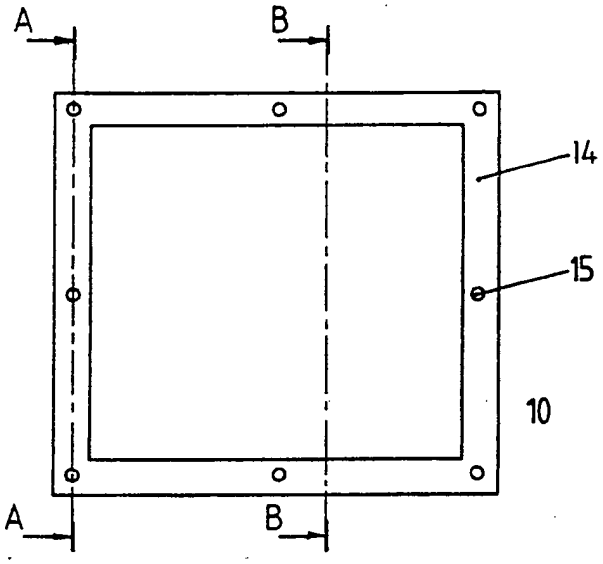

FIG 1.

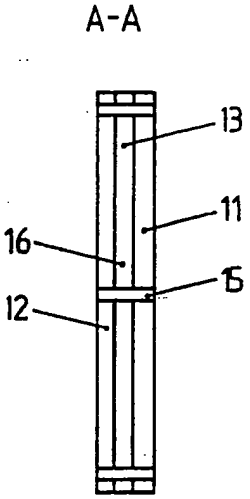

FIG 2.

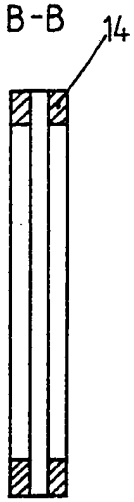

FIG 3.

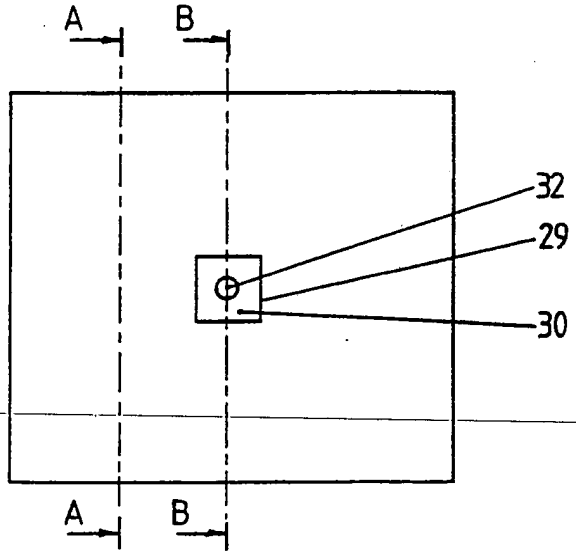

FIG 6.

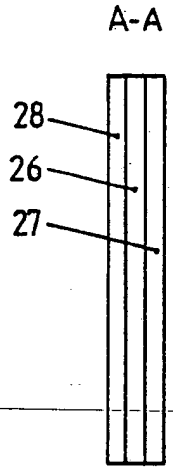

FIG 7.

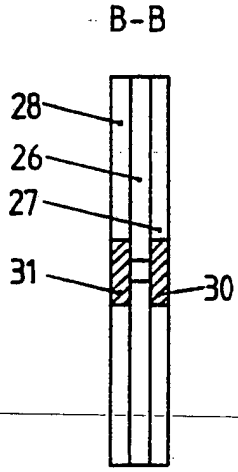

FIG 8.

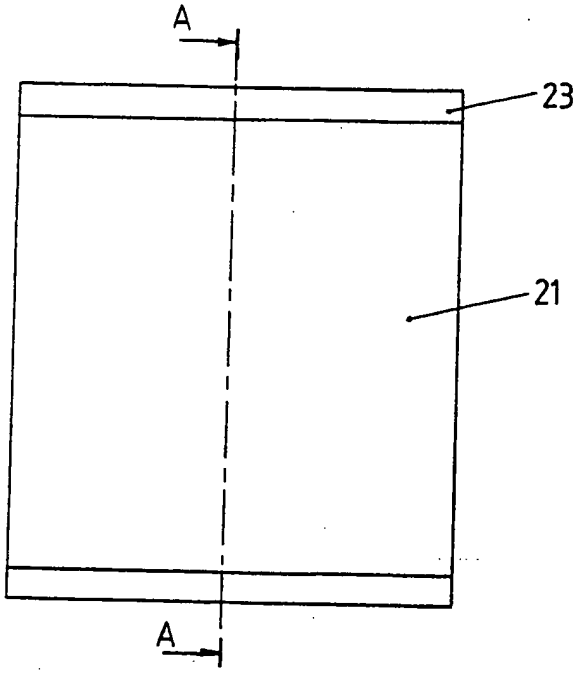

FIG 4

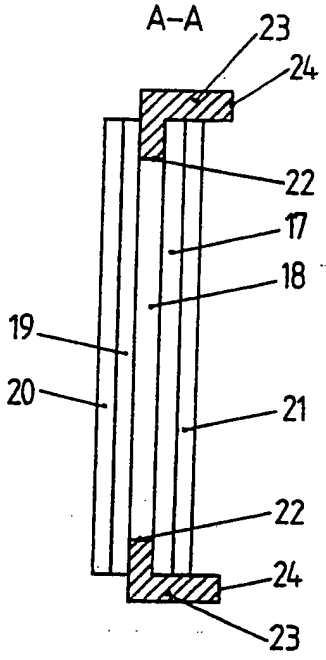

FIG 5

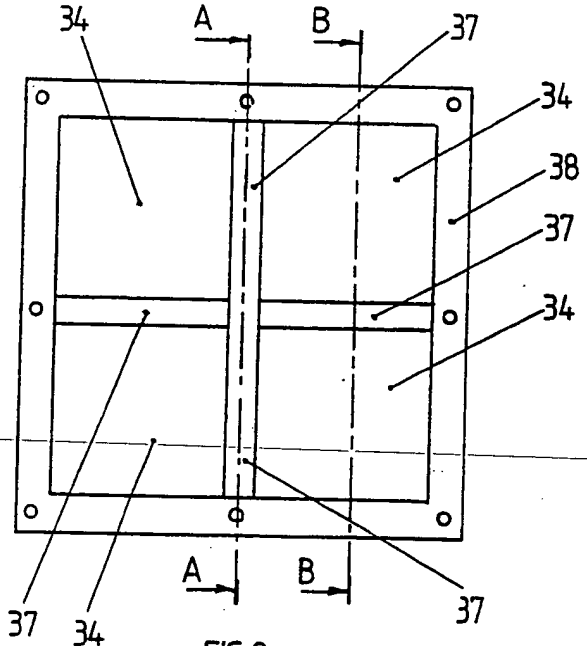

FIG 9

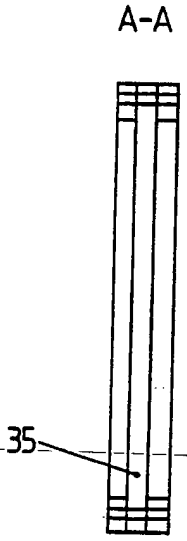

FIG 10

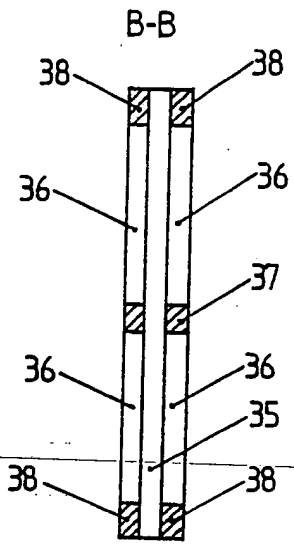

FIG 11

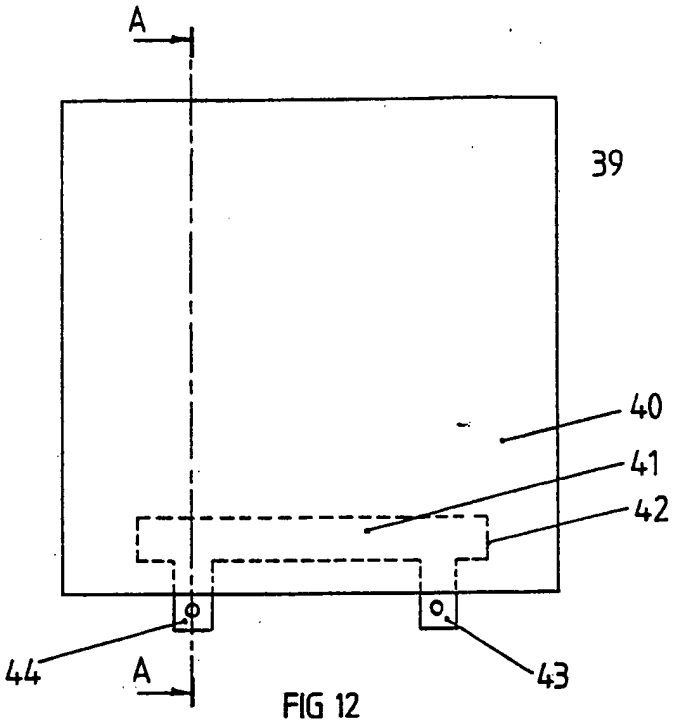

FIG 12

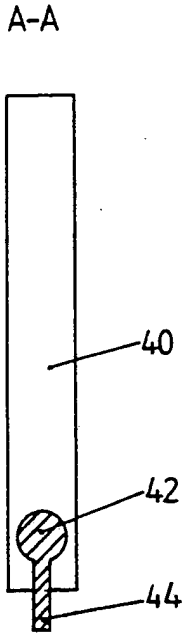

FIG 13

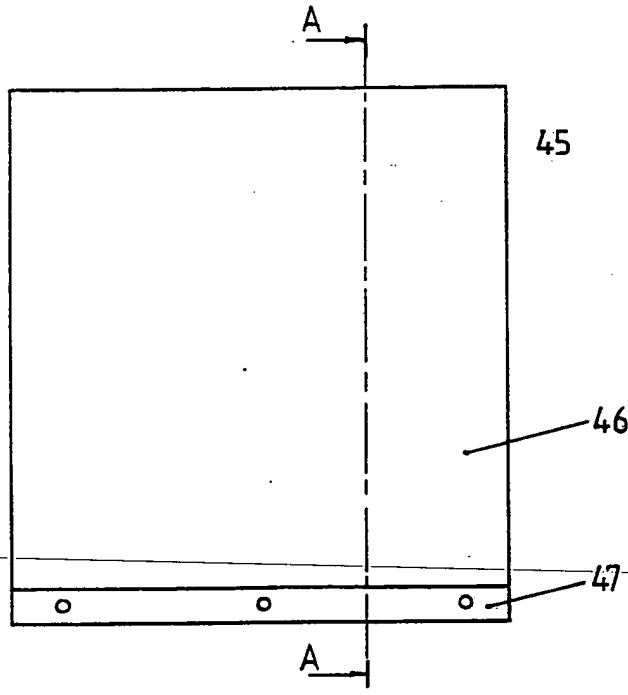

FIG 14

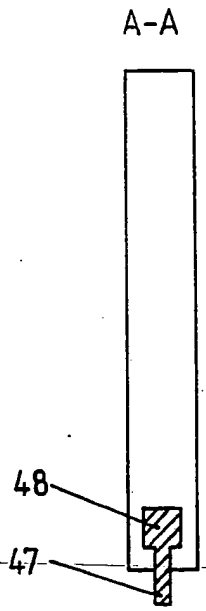

FIG 15

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[5] E06B 5/10, 5/12, 3/00; E04C 2/54; E05G 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC E06B 5/10, 5/12, 3/00; E04C 2/54; E05G 7/00, B32B 17/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim N .
A	US,A, 4,793,108 (BAIN et al.) 27 December 1988 (27.12.88) column 3, lines 43-45; column 4, line 1; Fig. 3.	1, 11
X	US,A, 4,704,174 (VALIMONT et al.) 3 November 1987 (03.11.87) column 4, line 49 - column 6, line 37; column 10, lines 9-21. Figs. 1,5.	1
A	US,A, 4,155,200 (EMANUEL) 22 May 1979 (22.05.79)	12

continued

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search

25 September 1992

Date of mailing of the international search report

7 Oct 1992 (07.10.92)

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
Y A	US,A, 2,750,312 (BLOOM et al.) 12 June 1956 (12.06.56) column 2, lines 8-11, 51-62 column 1, lines 15-24; column 2, line 51-column 3, line 23. Fig. 2.	13 1-5, 9-11
Y A	US,A, 2,679,467 (SHERTS) 25 May 1954 (25.05.54) column 2, lines 45-49; column 3, lines 31-34 column 3, line 4. Fig. 2.	13 1-5, 9
Y A	US,A, 2,403,061 (DOWNES) 2 July 1946 (02.07.46) column 2, lines 18-39, Fig. 2 column 2, lines 18-39, Fig. 2.	13 12
A	US,A, 2,392,129 (DOWNES) 1 January 1946 (01.01.46) column 1, line 42 - column 2, line 15, Fig. 2.	1
A	GB,A, 750,733 (PITTSBURGH PLATE GLASS COMPANY) 20 June 1956 (20.06.56) page 1, line 86 - page 2, line 8; page 2, lines 33-45; page 3, lines 5-18. Fig. 6.	1-5, 9, 12, 13
X Y	AU,B, 43578/58 (229691) (DEUTSCHE TAFELGLAS AKTIENGESELLSCHAFT DETAG) 21 May 1959 (21.05.59) page 4, lines 32-38, Figs. 6, 7, 10. page 4, lines 32-38, Figs. 6, 7, 10.	12 13
A	AU,B, 16738/76 (507982) (BFG GLASSGROUP) 16 February 1978 (16.02.78) pages 19-20, Fig. 4.	1,4,8,9,11
A	EP,A2 0320674 (METALLBAU KOLLER AG) 21 June 1989 (21.06.89) Abstract, Fig. 2.	1
A	EP, A1 0053233 (ARTUR FISCHER FORSCHUNG) 9 June 1982 (09.06.82) Abstract, Fig. 1.	12
A	DE, A1, 3810200 (GLASSBAU HAHN GmgH & Co KG) 12 October 1989 (12.10.89) Fig. 1.	1
A	FR, A1, 2597857 (CHAMPEAU) 30 October 1987 (30.10.87) Fig. 1.	1
X	Patent Abstracts of Japan, C-583, page 139, JP,A, 63-307145 (TAKASHI TAKEDA) 14 December 1988 (14.12.88)	1, 4, 9

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL APPLICATION NO. PCT/AU 92/00361

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member		
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US 4155200	CA 1116019		
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	NO 762762	SE 7608891	SE 7608892
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